Journal of the American College of Cardiology
© 2013 by the American College of Cardiology Foundation
Published by Elsevier Inc.
Vol. 62, No. 21, 2013
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2013.07.022

EDITORIAL COMMENT

Is the Wearable Cardioverter-Defibrillator the Answer for Early Post-Myocardial Infarction Patients at Risk for Sudden Death?

Mind the Gap*

Paul C. Zei, MD, PhD
Stanford, California

In patients with left ventricular (LV) dysfunction in the setting of an acute myocardial infarction (MI), current guidelines recommend implantable cardioverter-defibrillator (ICD) implantation only after waiting at least 40 days or 3 months, depending on whether the patient was revascularized or not (1). This is despite evidence that the early post-MI patient is potentially at significant risk of sudden cardiac death (SCD) and that long-term, ICDs are effective in preventing SCD. These recommendations stem directly from the results of 2 randomized clinical studies: The DINAMIT (Defibrillator in Acute Myocardial Infarction Trial) (2) and IRIS (Immediate Risk-Stratification Improves Survival) (3) studies were both clinical trials that randomized patients early after acute MI to receive optimal medical therapy with or without an ICD. Both showed no mortality benefit in patients receiving an ICD versus those who did not. Hence, the current state of affairs leaves a significant population of patients immediately after MI who may be at risk of arrhythmia-mediated SCD in a "gap of vulnerability."

See page 2000

The reasons for the lack of benefit of early ICD implantation after MI are unclear. Although both DINAMIT and IRIS showed that ICDs reduced arrhythmia-related deaths, patients who received appropriate ICD therapy had an increased risk of nonarrhythmic death that essentially offset the benefit of the ICD. Those higher-risk patients tended toward elevated baseline heart rate, suggesting increased sympathetic tone and poorer clinical status. Some portion of the post-MI population will eventually recover LV function, rendering them at lower risk of SCD. Moreover, causes of sudden death in this patient population may also be nonarrhythmic, including reinfarction and LV wall rupture (4).

The wearable cardioverter-defibrillator (WCD) was approved by the U.S. Food and Drug Administration in 2002, with indications for use in patients who are at risk of SCD but are unable or unwilling to receive an ICD (5). According to guidelines from the American College of Cardiology/American Heart Association/European Society of Cardiology and others, candidates for a WCD include patients who are at high risk after recent MI or cardiac intervention, who have had an ICD removed due to infection, and who are awaiting reimplantation, or who are awaiting cardiac transplantation (1); however, there are no randomized trials evaluating the efficacy of WCD in these settings.

To date, there have only been a handful of studies evaluating the efficacy of the WCD, with particularly few focused on early post-MI patient populations. The WEARIT/BIROAD (6) trial, initially two separate clinical studies that the U.S. Food and Drug Administration requested be combined into a single study, evaluated 289 patients with indications for a WCD in a nonrandomized fashion. Six of 8 appropriate therapies were successful, with failures attributed to incorrect device placement (6). Chung et al. (7) reported the outcomes among patients (n = 3,569) tracked in a registry sponsored by the manufacturer of the WCD (LifeVest, Zoll, Pittsburgh, Pennsylvania), of which 21.4% had depressed LV function and recent MI or coronary artery bypass graft (CABG) surgery. Among this subset of 584 patients, 12 (2.1%) received appropriate WCD therapies for ventricular arrhythmia (VA). Zishiri et al. (8) compared patients after percutaneous coronary intervention or CABG with left ventricular ejection fraction (EF) ≤35% with or without WCD therapy; the treated cohort was derived again from the manufacturer's database and compared with a single-center post–percutaneous coronary intervention or post-CABG population. Mortality was significantly lower in the WCD versus the non-WCD group (3% vs. 7%), and the rate of appropriate WCD therapy was 1.3%.

In this issue of the *Journal*, Epstein et al. (9) attempt to address the specific question of whether the WCD can impart protection against SCD in the patient group with depressed LV function immediately after acute MI, prior to ICD eligibility, using the aforementioned manufacturer's database. The investigators culled patients prescribed a WCD with acute MI and EF ≤35%; 8,543 patients fell within this gap population. Among these, 133 patients (1.6%) received appropriate shocks, of whom 91% survived the treated event; WCD

*Editorials published in the *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of *JACC* or the American College of Cardiology.

From the Department of Medicine, Cardiac Electrophysiology, Stanford University, Stanford, California. Dr. Zei has reported that he has no relationships relevant to the contents of this paper to disclose.

successfully converted 209 of 252 VA events (81.6%). Overall survival in this group was 73% after 3 months, compared with 96% in patients who were not treated. The investigators point out that, given the caveat of slightly different populations in each study, the overall mortality rate of 4% in their WCD cohort is higher than that observed in DINAMIT (1.8%) and IRIS (2.9%). This may very well be due to the selection bias inherent in the manufacturer's database, or perhaps the likely tighter control of medical therapy inherent in randomized trials such as DINAMIT or IRIS. The investigators also point out the similarity in rates of treated VA in their cohort compared with the rate of sudden death in the VALIANT (Valsartan in Acute Myocardial Infarction Trial) (1.4% at 30 days and 2.5% between 1 and 6 months), with the caveat that accurately attributing the deaths in VALIANT to ventricular arrhythmias was not possible. In fact, autopsy findings suggest that about one-half of the deaths in VALIANT may be nonarrhythmic (4).

Given the limitations inherent in using a manufacturer's database and in comparing the results of clinical studies with divergent patient populations, methodologies, and goals, it seems we can still draw some conclusions from this current study. First, there is a small but definite subpopulation of post-MI patients who are at risk of SCD during the mandated waiting period for ICD implantation. Patients who received appropriate WCD therapy appear to have increased mortality. Whether this is due to the negative impact of VA on clinical status, or that VA is a marker for poor clinical outcomes, or that the shocks themselves contribute to clinical destabilization is unclear. It is also not clear whether those who received inappropriate WCD therapies also had poorer outcomes. That being said, this population appears effectively treated by the WCD for VA.

There are potential additional benefits of the WCD that are more difficult to assess. As the WCD is essentially an event recorder, patients with WCD are likely more closely monitored. Compliance with WCD is high (7), and it is possible the constant, conspicuous reminder of one's vulnerability to SCD may increase patient compliance to the medical regimen. Currently, the primary alternative noninvasive intervention is the automated external defibrillator. Comparative efficacy between the automated external defibrillator and WCD has never been evaluated, but it stands to reason that the more complete monitoring with the WCD makes arrhythmia detection more likely. Finally, the sartorial considerations of the WCD patient are unclear.

A major limitation to this study is the selection bias inherent in the database used. Patients deemed at particularly high risk are more likely targeted for WCD therapy, as the high mortality rate of patients in the database attests. To point, a randomized clinical trial (Vest Prevention of Early Sudden Death Trial and VEST Registry) is currently enrolling patients and will hopefully address this concern. Another important limitation of this study is the lack of data about potential arrhythmia underdetection with the WCD. However, given the low mortality rate in nontreated patients, it is likely that few lethal arrhythmias were underdetected.

So in the end, this study still does not quite answer the elusive question of how to best risk-stratify post-MI low-EF patients in the early days after infarction. Some portion will go on to recover LV function, whereas others will fail to do so and will eventually meet criteria for ICD therapy. A fraction of patients will suffer SCD during this waiting period. Does the relatively low incidence of risk within this period warrant prescribing a WCD for every patient with low EF after MI? Should the WCD be prescribed for a fixed duration? If not, what are the criteria for determining when it is safe to stop wearing the WCD? Despite these unanswered questions, this study provides a bit more enlightenment on this challenging subject.

Reprint requests and correspondence: Dr. Paul C. Zei, Department of Medicine, Cardiac Electrophysiology, Stanford University, 300 Pasteur Drive, Stanford, California 94305. E-mail: paulzei@stanford.edu.

REFERENCES

1. Epstein AE, DiMarco JP, Ellenbogen KA, et al. ACC/AHA/HRS 2008 guidelines for device-based therapy of cardiac rhythm abnormalities: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the ACC/AHA/NASPE 2002 Guideline Update for Implantation of Cardiac Pacemakers and Antiarrhythmia Devices). J Am Coll Cardiol 2008;51:e1–62.
2. Hohnloser SH, Kuck KH, Dorian P, et al., for the DINAMIT Investigators. Prophylactic use of an implantable cardioverter-defibrillator after acute myocardial infarction. N Engl J Med 2004;351:2481–8.
3. Steinbeck G, Andresen D, Seidl K, et al., for the IRIS Investigators. Defibrillator implantation early after myocardial infarction. N Engl J Med 2009;361:1427–36.
4. Pouleur AC, Barkoudah E, Umo H, et al. Pathogenesis of sudden unexpected death in a clinical trial of patients with myocardial infarction and left ventricular dysfunction, heart failure, or both. Circulation 2010;122:597–602.
5. Centers for Medicare & Medicaid Services. National Coverage Determination for Centers for Medicare & Medicaid Services. [Online index]. Available at: http://www.cms.gov/medicare-coverage-database/details/ncddetails.aspx. Accessed January 29, 2013.
6. Feldman A, Klein H, Moss A, et al., for the WEARIT Investigators and Coordinators and the BIROAD Investigators and Coordinators. Use of a wearable defibrillator in terminating tachyarrhythmias in patients at high risk for sudden death: results of WEARIT/BIROAD. Pacing Clin Electrophysiol 2004;27:4–9.
7. Chung MK, Szymkiewicz SJ, Shao M, et al. Aggregate national experience with the wearable cardioverter-defibrillator. Event rates, compliance, and survival. J Am Coll Cardiol 2010;56:194–203.
8. Zishiri ET, Williams S, Cronin E, et al. Early risk of mortality after coronary artery revascularization in patients with left ventricular dysfunction and potential role of the wearable cardioverter defibrillator. Circ Arrhythm Electrophysiol 2013;6:117–28.
9. Epstein AE, Abraham WT, Bianco NR, et al. Wearable cardioverter-defibrillator use in patients perceived to be at high risk early post myocardial infarction. J Am Coll Cardiol 2013;62:2000–7.

Key Words: defibrillation ■ implantable cardioverter-defibrillator ■ sudden cardiac arrest ■ wearable cardioverter-defibrillator.